



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

| APPLICATION NO. | FILING DATE | FIRST NAMED INVENTOR | ATTORNEY DOCKET NO. | CONFIRMATION NO. |
|--|-------------|----------------------|-------------------------------|------------------|
| 09/645,903 | 08/25/2000 | Li Li | 2269-3361.2US (97-0663.02) | 6825 |
| 24247 | 7590 | 11/14/2007 | EXAMINER | |
| TRASK BRITT P.O. BOX 2550 SALT LAKE CITY, UT 84110 | | | SUCH, MATTHEW W | |
| | | | ART UNIT | PAPER NUMBER |
| | | | 2891 | |
| | | | NOTIFICATION DATE | DELIVERY MODE |
| | | | 11/14/2007 | ELECTRONIC |

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTOMail@traskbritt.com

| | | | |
|------------------------------|--------------------------------------|-------------------------------|--|
| Office Action Summary | Application No. 09/645,903 | Applicant(s) LI, LI | |
| | Examiner Matthew W. Such | Art Unit 2891 | |

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 16 October 2007.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 10-28 and 30-34 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 10-28 and 30-34 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claim 10 is rejected under 35 U.S.C. 102(b) as being anticipated by Herberg ('026) who teaches a method of etching to form a semiconductor device by forming a contact opening in a dielectric layer (represented by the hole formed in Element 5) having an underlying metal-containing layer (Elements 2, 3, 4, in combination). The contact opening begins in Fig. 2 and a solution consisting essentially of a nitric acid solution (Col. 3, Lines 29-30; Fig. 4) is first applied to the contact opening. This step is followed by a phosphoric acid dip (Col. 3, Line 35, Fig. 6). The manner in which the claim is written does not require that the metal polymer and oxide polymer actually be in the contact opening, but merely that the claimed recipe will remove these materials if they are present.

3. Claim 10 is rejected under 35 U.S.C. 102(b) as being anticipated by Temple ('385) who teaches a method of etching to form a semiconductor device by forming a contact opening (Element 70 in Fig. 4A) in a dielectric layer (Element 90) having an underlying metal-containing layer (Element 82). The contact opening is etched with a solution consisting essentially of a

Art Unit: 2891

nitric acid solution (Col. 13, Lines 1-2) which is first applied to the contact opening since it is present while the etching is ongoing down from the top. This step is followed by a phosphoric acid dip (Col. 15, Lines 5-15). The manner in which the claim is written does not require that the metal polymer and oxide polymer actually be in the contact opening, but merely that the claimed recipe will remove these materials if they are present.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohta ('774) in view of Takahashi ('695).

Ohta teaches a method of etching to form a semiconductor device by forming a contact opening in a dielectric (represented by the hole formed at Elements 18, 19, 20, 21). The contact opening begins in Fig. 2c and a solution consisting essentially of a nitric acid solution (Col. 2, Line 54) is first applied to the contact opening. This step is followed by a phosphoric acid dip (Col. 2, Line 60). Ohta does not teach the conventional detail of an underlying metal-containing layer, common for electrical connections in semiconductor devices.

Takahashi teaches an underlying metal-containing layer (Element 3a and 3b) on a semiconductor substrate (Element 1). The claim does not limit what the metal-containing layer

Art Unit: 2891

is underlying, and Takahashi teaches that the metal-containing layer is underlying dielectric layers (Elements 4, 5a, 5b, 6). It would have been obvious to one of ordinary skill in the art at the time the invention was made to include a metal-containing layer underlying the dielectric on the semiconductor substrate in order to form electrical connections to the semiconductor devices (Takahashi Col. 4, Lines 46-65). The manner in which the claim is written does not require that the metal polymer and oxide polymer actually be in the contact opening, but merely that the claimed recipe will remove these materials if they are present. Regarding the specific concentration, time, and temperature claimed, one of ordinary skill in the art would have found it prima facie obvious at the time of the invention to select the concentration merely by following the teachings of the references because there is not evidence of criticality. In this regard, it is well settled that it is not inventive to determine (by mere routine experimentation) the optimum values of a result-effective variable. *In re Peterson*, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382 (Fed. Cir, 2003) ["The normal desire of scientist or artisans to determine where in a disclosed set of percentage ranges is the optimum combination of percentages."]; *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980) ["Discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."]; *In re Aller*, 220 F. 2d 454,456, 105 USPQ 233, 235, (CCPA 1955) ["Where the general conditions of a claim are discloses in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."]. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the conditions of claims 11-17 in order to ensure that the etching is performed.

Art Unit: 2891

6. Claims 11-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Herberg ('026). Regarding the specific concentration, time, and temperature claimed, one of ordinary skill in the art would have found it prima facie obvious at the time of the invention to select the concentration merely by following the teachings of the references because there is not evidence of criticality. In this regard, it is well settled that it is not inventive to determine (by mere routine experimentation) the optimum values of a result-effective variable. *In re Peterson*, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382 (Fed. Cir, 2003) ["The normal desire of scientist or artisans to determine where in a disclosed set of percentage ranges is the optimum combination of percentages."]; *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980) ["Discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."]; *In re Aller*, 220 F. 2d 454,456, 105 USPQ 233, 235, (CCPA 1955) ["Where the general conditions of a claim are discloses in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."]. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the conditions of claims 11-17 in order to ensure that the etching is performed.

7. Claims 11-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Temple ('385). Regarding the specific concentration, time, and temperature claimed, one of ordinary skill in the art would have found it prima facie obvious at the time of the invention to select the concentration merely by following the teachings of the references because there is not evidence of criticality. In this regard, it is well settled that it is not inventive to determine (by mere routine experimentation) the optimum values of a result-effective variable. *In re Peterson*, 315 F.3d

Art Unit: 2891

1325, 1330, 65 USPQ2d 1379, 1382 (Fed. Cir, 2003) ["The normal desire of scientist or artisans to determine where in a disclosed set of percentage ranges is the optimum combination of percentages."]; *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980) ["Discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."]; *In re Aller*, 220 F. 2d 454,456, 105 USPQ 233, 235, (CCPA 1955) ["Where the general conditions of a claim are discloses in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."]. Therefore, it would have been obvious to a person of ordinary skill in the art at the time of the invention to use the conditions of claims 11-17 in order to ensure that the etching is performed.

8. Claims 15-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Temple ('385) in view of Henry ('218).

Temple does not teach that the phosphoric acid containing solution used to etch silicon nitride further includes hydrofluoric acid and ammonium fluoride. Henry teaches forming a phosphoric acid containing solution, which also includes hydrofluoric acid and ammonium fluoride, as a selective etchant for silicon nitride films (Abstract; Col. 2, Lines 30-36; Col. 3, Lines 42-62; Col. 4, Lines 50-58). It would have been obvious to one of ordinary skill in the art at the time the invention was made to add both hydrofluoric acid and ammonium fluoride into the phosphoric acid containing solution. Henry teaches that adding these fluorine containing chemicals both buffers the solution against overly aggressive etching rates and also allows for very precise patterns to be etching into the silicon nitride at etching rates which are known and controllable to the Angstrom level (Col. 3, Lines 11-12, 42-45, 58-66; Col. 4, Lines 1-5).

Art Unit: 2891

Furthermore, Henry teaches that the etching rates of silicon nitride are known with Angstrom precision with the phosphoric acid containing solution further including hydrofluoric acid and ammonium fluoride, allowing for extremely precise thicknesses of silicon nitride to be etched selectively (Col. 4, Lines 1-5, for example).

Temple does not teach the concentration of the phosphoric acid containing solution is between about 100 volumes of water to about 1 volume of phosphoric acid and about 1 volume of water to about 1 volume of phosphoric acid as the etching solution for the silicon nitride film. Henry teaches using a phosphoric acid containing solution for etching silicon nitride with 36-34 volumes of water and 1-10 volumes of phosphoric acid, which is in the claimed range (Col. 3, Lines 45-63 and Col. 4, Lines 50-58). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the concentration taught by Henry in the phosphoric acid solution of Temple in order to etch the silicon nitride film selectively from photoresist materials and semiconductor films and introduce an etch rate which allows for the depth of etching to known based on the time of etching (Henry Col. 3, Lines 58-64 and Col. 4, Lines 58-63). Temple does not teach the temperature or time which the silicon nitride etching is conducted. Henry teaches etching silicon nitride at room temperature (Col. 4, Line 1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the cleaning the partial via with a phosphoric-acid solution at room temperature, anywhere from 20-25 degrees Celsius in order to save money and energy since performing the task at room temperature does not require any additional heating or cooling means to raise or lower the temperature. Furthermore, Henry teaches that the etching rates of silicon nitride are known with Angstrom precision under room temperature conditions, allowing for extremely precise

Art Unit: 2891

thicknesses of silicon nitride to be etched selectively (Col. 4, Lines 1-5, for example). Henry further teaches that the etching rate of silicon nitride using the solution is from 2-4 nm/minute (Col. 4, Lines 1-5) and the silicon nitride film thickness can be etched within the range of 10 seconds to 10 minutes depending on the overall thickness.

In re Peterson, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382 (Fed. Cir, 2003) ["The normal desire of scientist or artisans to determine where in a disclosed set of percentage ranges is the optimum combination of percentages."]; *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980) ["Discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."]; *In re Aller*, 220 F. 2d 454,456, 105 USPQ 233, 235, (CCPA 1955) ["Where the general conditions of a claim are discloses in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."].

9. Claims 15-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ohta (' 774) in view of Takahashi (' 695) as applied to claim 10 above, and further in view of Henry (' 218).

Ohta in view of Takahashi does not teach that the phosphoric acid containing solution used to etch silicon nitride further includes hydrofluoric acid and ammonium fluoride. Henry teaches forming a phosphoric acid containing solution, which also includes hydrofluoric acid and ammonium fluoride, as a selective etchant for silicon nitride films (Abstract; Col. 2, Lines 30-36; Col. 3, Lines 42-62; Col. 4, Lines 50-58). It would have been obvious to one of ordinary skill in the art at the time the invention was made to add both hydrofluoric acid and ammonium fluoride into the phosphoric acid containing solution. Henry teaches that adding these fluorine containing chemicals both buffers the solution against overly aggressive etching rates and also allows for

Art Unit: 2891

very precise patterns to be etching into the silicon nitride at etching rates which are known and controllable to the Angstrom level (Col. 3, Lines 11-12, 42-45, 58-66; Col. 4, Lines 1-5).

Furthermore, Henry teaches that the etching rates of silicon nitride are known with Angstrom precision with the phosphoric acid containing solution further including hydrofluoric acid and ammonium fluoride, allowing for extremely precise thicknesses of silicon nitride to be etched selectively (Col. 4, Lines 1-5, for example).

Ohta in view of Takahashi does not teach the concentration of the phosphoric acid containing solution is between about 100 volumes of water to about 1 volume of phosphoric acid and about 1 volume of water to about 1 volume of phosphoric acid as the etching solution for the silicon nitride film. Henry teaches using a phosphoric acid containing solution for etching silicon nitride with 36-34 volumes of water and 1-10 volumes of phosphoric acid, which is in the claimed range (Col. 3, Lines 45-63 and Col. 4, Lines 50-58). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the concentration taught by Henry in the phosphoric acid solution of Temple in order to etch the silicon nitride film selectively from photoresist materials and semiconductor films and introduce an etch rate which allows for the depth of etching to known based on the time of etching (Henry Col. 3, Lines 58-64 and Col. 4, Lines 58-63). Ohta in view of Takahashi does not teach the temperature or time which the silicon nitride etching is conducted. Henry teaches etching silicon nitride at room temperature (Col. 4, Line 1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the cleaning the partial via with a phosphoric-acid solution at room temperature, anywhere from 20-25 degrees Celsius in order to save money and energy since performing the task at room temperature does not require any additional heating or cooling means

to raise or lower the temperature. Furthermore, Henry teaches that the etching rates of silicon nitride are known with Angstrom precision under room temperature conditions, allowing for extremely precise thicknesses of silicon nitride to be etched selectively (Col. 4, Lines 1-5, for example). Henry further teaches that the etching rate of silicon nitride using the solution is from 2-4 nm/minute (Col. 4, Lines 1-5) and the silicon nitride film thickness can be etched within the range of 10 seconds to 10 minutes depending on the overall thickness.

In re Peterson, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382 (Fed. Cir, 2003) ["The normal desire of scientist or artisans to determine where in a disclosed set of percentage ranges is the optimum combination of percentages."]; *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980) ["Discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."]; *In re Aller*, 220 F. 2d 454,456, 105 USPQ 233, 235, (CCPA 1955) ["Where the general conditions of a claim are discloses in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."].

10. Claims 21, 26-28 and 30-31 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krautschneider (WO 97/03469; the Examiner refers to English equivalent US 5,943,572 for the purposes of the present Office Action) in view of Hu ('020) in view of Henry ('218).

Krautschneider teaches a method of forming a via in a dielectric layer (Element 5; Figs. 2-3) and an underlying barrier layer (Element 6; Figs. 2-3) for a semiconductor device, such as a flash memory. A partial via (Element 4; Figs. 2-3) is formed in the dielectric layer to expose at least a portion of the barrier layer (Fig. 2). The partial via is cleaned with a phosphoric acid containing solution (Col. 6, Lines 55-60). The barrier layer is etched with a nitric acid

Art Unit: 2891

containing solution after the cleaning (Col. 6, Lines 61-65) forming a full via containing a trace (Element 6'; Fig. 3) on the bottom surface thereof. Since the nitric acid containing solution is applied to the full via the instant etching is completed. Krautschneider teaches that the trace (Element 6') is a polysilicon floating gate electrode for a memory cell and does not teach that the trace is a metal containing material.

Hu teaches using polysilicon, silicide (metal containing polysilicon) and metal materials as floating gate electrodes in memory cells (Col. 4, Lines 2-4 and 33-35). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the floating gate trace of Krautschneider with, for example, a metal containing material such as a silicide, as taught by Hu since the materials are conventional functional equivalents for floating gate electrodes in memory cells. It has been held that the selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07.

Krautschneider does not teach that the phosphoric acid solution contains hydrofluoric acid and ammonium fluoride. Henry teaches forming a phosphoric acid containing solution, which also includes hydrofluoric acid and ammonium fluoride, as a selective etchant for silicon nitride films (Abstract; Col. 2, Lines 30-36; Col. 3, Lines 42-62; Col. 4, Lines 50-58). It would have been obvious to one of ordinary skill in the art at the time the invention was made to add both hydrofluoric acid and ammonium fluoride into the phosphoric acid containing solution. Henry teaches that adding these fluorine containing chemicals both buffers the solution against overly aggressive etching rates and also allows for very precise patterns to be etching into the

Art Unit: 2891

silicon nitride at etching rates which are known and controllable to the Angstrom level (Col. 3, Lines 11-12, 42-45, 58-66; Col. 4, Lines 1-5).

Krautschneider does not teach the concentration of the phosphoric acid containing solution is between about 100 volumes of water to about 1 volume of phosphoric acid and about 1 volume of water to about 1 volume of phosphoric acid as the etching solution for the silicon nitride film. Henry teaches using a phosphoric acid containing solution for etching silicon nitride with 36-34 volumes of water and 1-10 volumes of phosphoric acid, which is in the claimed range (Col. 3, Lines 45-63 and Col. 4, Lines 50-58). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the concentration taught by Henry in the phosphoric acid solution of Krautschneider in order to etch the silicon nitride film selectively from photoresist materials and semiconductor films and introduce an etch rate which allows for the depth of etching to known based on the time of etching (Henry Col. 3, Lines 58-64 and Col. 4, Lines 58-63).

Krautschneider does not teach the temperature under which the cleaning the partial via is conducted. Henry teaches etching silicon nitride at room temperature (Col. 4, Line 1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the cleaning the partial via with a phosphoric-acid solution at room temperature, anywhere from 20-25 degrees Celsius in order to save money and energy since performing the task at room temperature does not require any additional heating or cooling means to raise or lower the temperature. Furthermore, Henry teaches that the etching rates of silicon nitride are known with Angstrom precision under room temperature conditions, allowing for extremely precise thicknesses of silicon nitride to be etched selectively (Col. 4, Lines 1-5, for example).

Krautschneider does not teach the time under which the phosphoric acid containing solution is applied to the via to remove the silicon nitride film, which can be, for example, 20 nm thick (Col. 6, Lines 37-38). However, Henry further teaches that the etching rate of silicon nitride using the solution is from 2-4 nm/minute (Col. 4, Lines 1-5) and since the silicon nitride film is 20 nm thick, the etching rate will be from 5-10 minutes, which is in the claimed range.

In re Peterson, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382 (Fed. Cir, 2003) ["The normal desire of scientist or artisans to determine where in a disclosed set of percentage ranges is the optimum combination of percentages."]; *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980) ["Discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."]; *In re Aller*, 220 F. 2d 454,456, 105 USPQ 233, 235, (CCPA 1955) ["Where the general conditions of a claim are discloses in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."].

11. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Krautschneider (WO 97/03469; the Examiner refers to English equivalent US 5,943,572 for the purposes of the present Office Action) in view of Hu ('020) in view of Sakata ('787).

Krautschneider teaches a method of forming a via in a dielectric layer (Element 5; Figs. 2-3) and an underlying barrier layer (Element 6; Figs. 2-3) for a semiconductor device, such as a flash memory. A partial via (Element 4; Figs. 2-3) is formed in the dielectric layer to expose at least a portion of the barrier layer (Fig. 2). The partial via is cleaned with a phosphoric acid containing solution (Col. 6, Lines 55-60). The barrier layer is etched with a nitric acid containing solution after the cleaning (Col. 6, Lines 61-65) forming a full via containing a trace

(Element 6'; Fig. 3) on the bottom surface thereof. Since the nitric acid containing solution is applied to the full via the instant etching is completed. Krautschneider teaches that the trace (Element 6') is a polysilicon floating gate electrode for a memory cell and does not teach that the trace is a metal containing material.

Hu teaches using polysilicon, silicide (metal containing polysilicon) and metal materials as floating gate electrodes in memory cells (Col. 4, Lines 2-4 and 33-35). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the floating gate trace of Krautschneider with, for example, a metal containing material such as a silicide, as taught by Hu since the materials are conventional functional equivalents for floating gate electrodes in memory cells. It has been held that the selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07.

Krautschneider does not teach the concentration of the HF – nitric acid containing solution is from 50-100%. Sakata teaches using high concentration HF – nitric acid containing solution between 50-100% to etch silicon oxide films (Col. 7, Lines 47-54). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the HF – nitric acid solution of Krautschneider between 50-100% to perform a complete dissolution of the silicon oxide film (as shown in Fig. 3 of Krautschneider and Col. 7, Lines 47-54 of Sakata). *In re Peterson*, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382 (Fed. Cir, 2003) ["The normal desire of scientist or artisans to determine where in a disclosed set of percentage ranges is the optimum combination of percentages."]; *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA

Art Unit: 2891

1980) ["Discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."]; *In re Aller*, 220 F. 2d 454,456, 105 USPQ 233, 235, (CCPA 1955) ["Where the general conditions of a claim are disclosed in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."].

12. Claims 33 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Krautschneider (WO 97/03469; the Examiner refers to English equivalent US 5,943,572 for the purposes of the present Office Action) in view of Hu ('020) in view of Henry ('218).

Krautschneider teaches a method of forming a via in a dielectric layer (Element 5; Figs. 2-3) and an underlying barrier layer (Element 6; Figs. 2-3) for a semiconductor device, such as a flash memory. A partial via (Element 4; Figs. 2-3) is formed in the dielectric layer to expose at least a portion of the barrier layer (Fig. 2). The partial via is cleaned with a phosphoric acid containing solution (Col. 6, Lines 55-60). The barrier layer is etched with a nitric acid containing solution after the cleaning (Col. 6, Lines 61-65) forming a full via containing a trace (Element 6'; Fig. 3) on the bottom surface thereof. Since the nitric acid containing solution is applied to the full via the instant etching is completed. Krautschneider teaches that the trace (Element 6') is a polysilicon floating gate electrode for a memory cell and does not teach that the trace is a metal containing material.

Hu teaches using polysilicon, silicide (metal containing polysilicon) and metal materials as floating gate electrodes in memory cells (Col. 4, Lines 2-4 and 33-35). It would have been obvious to one of ordinary skill in the art at the time the invention was made to form the floating gate trace of Krautschneider with, for example, a metal containing material such as a silicide, as

taught by Hu since the materials are conventional functional equivalents for floating gate electrodes in memory cells. It has been held that the selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945) See also *In re Leshin*, 227 F.2d 197, 125 USPQ 416 (CCPA 1960). MPEP § 2144.07.

Krautschneider does not teach the concentration of the phosphoric acid containing solution is between about 100 volumes of water to about 1 volume of phosphoric acid and about 1 volume of water to about 1 volume of phosphoric acid as the etching solution for the silicon nitride film. Henry teaches using a phosphoric acid containing solution for etching silicon nitride with 36-34 volumes of water and 1-10 volumes of phosphoric acid, which is in the claimed range (Col. 3, Lines 45-63 and Col. 4, Lines 50-58). It would have been obvious to one of ordinary skill in the art at the time the invention was made to use the concentration taught by Henry in the phosphoric acid solution of Krautschneider in order to etch the silicon nitride film selectively from photoresist materials and semiconductor films and introduce an etch rate which allows for the depth of etching to known based on the time of etching (Henry Col. 3, Lines 58-64 and Col. 4, Lines 1-5, 58-63). Furthermore, this solution allows for etching of silicon nitride to produce excellent definitions in the resulting film, so the etchant is precise (Henry Col. 3, Lines 11-12).

Krautschneider does not teach the temperature under which the cleaning the partial via is conducted. Henry teaches etching silicon nitride at room temperature (Col. 4, Line 1). It would have been obvious to one of ordinary skill in the art at the time the invention was made to perform the cleaning the partial via with a phosphoric-acid solution at room temperature,

Art Unit: 2891

anywhere from 20-25 degrees Celsius in order to save money and energy since performing the task at room temperature does not require any additional heating or cooling means to raise or lower the temperature. Furthermore, Henry teaches that the etching rates of silicon nitride are known with Angstrom precision under room temperature conditions, allowing for extremely precise thicknesses of silicon nitride to be etched selectively (Col. 4, Lines 1-5, for example).

In re Peterson, 315 F.3d 1325, 1330, 65 USPQ2d 1379, 1382 (Fed. Cir, 2003) ["The normal desire of scientist or artisans to determine where in a disclosed set of percentage ranges is the optimum combination of percentages."]; *In re Boesch*, 617 F.2d 272, 276, 205 USPQ 215, 219 (CCPA 1980) ["Discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art."]; *In re Aller*, 220 F. 2d 454,456, 105 USPQ 233, 235, (CCPA 1955) ["Where the general conditions of a claim are discloses in the prior art, it is not inventive to discover the optimum or workable ranges by routine experimentation."].

Response to Arguments

13. Applicant's arguments with respect to claims 10-28 and 30-34 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure: Shiagawa ('871) teaches methods of removing RIE polymer residue and Mastrangelo ('469) teaches methods of etching with nitric acid and phosphoric acid containing solutions.

Art Unit: 2891

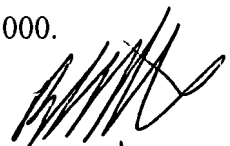
Contact Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew W. Such whose telephone number is (571) 272-8895. The examiner can normally be reached on Monday - Friday 9AM-5PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Bradley W. Baumeister can be reached on (571) 272-1722. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew W. Such
Examiner
Art Unit 2891



B. WILLIAM BAUMEISTER
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800

MWS
11/2/07